



# Automating Cataloging and Discovery of Services for Service-Oriented Robotic Systems

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# Automating Cataloging and Discovery of Services for Service-Oriented Robotic Systems

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LARS 2014, São Carlos/SP



# Agenda

Introduction

Developing RoboSeT

Case Study

Discussion

Conclusion and Future Work

# Introduction

- Robots have been used in several areas of the society
- Complexity and diversity challenge the development of robotic systems
- Service-Oriented Architecture (SOA) promotes better reusability and flexibility to robotic systems
- Several Service-Oriented Robotic Systems (SORS) can be found in the literature
- Development environments for SORS are also available

# Introduction

- Motivation:
  - SORS development environments do not provide facilities for location and selection of services

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# Introduction

- Motivation:
  - SORS development environments do not provide facilities for location and selection of services

## Which service controls a laser sensor?

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# Introduction

- Motivation:
  - SORS development environments do not provide facilities for location and selection of services

Is this service the  
most indicated one?

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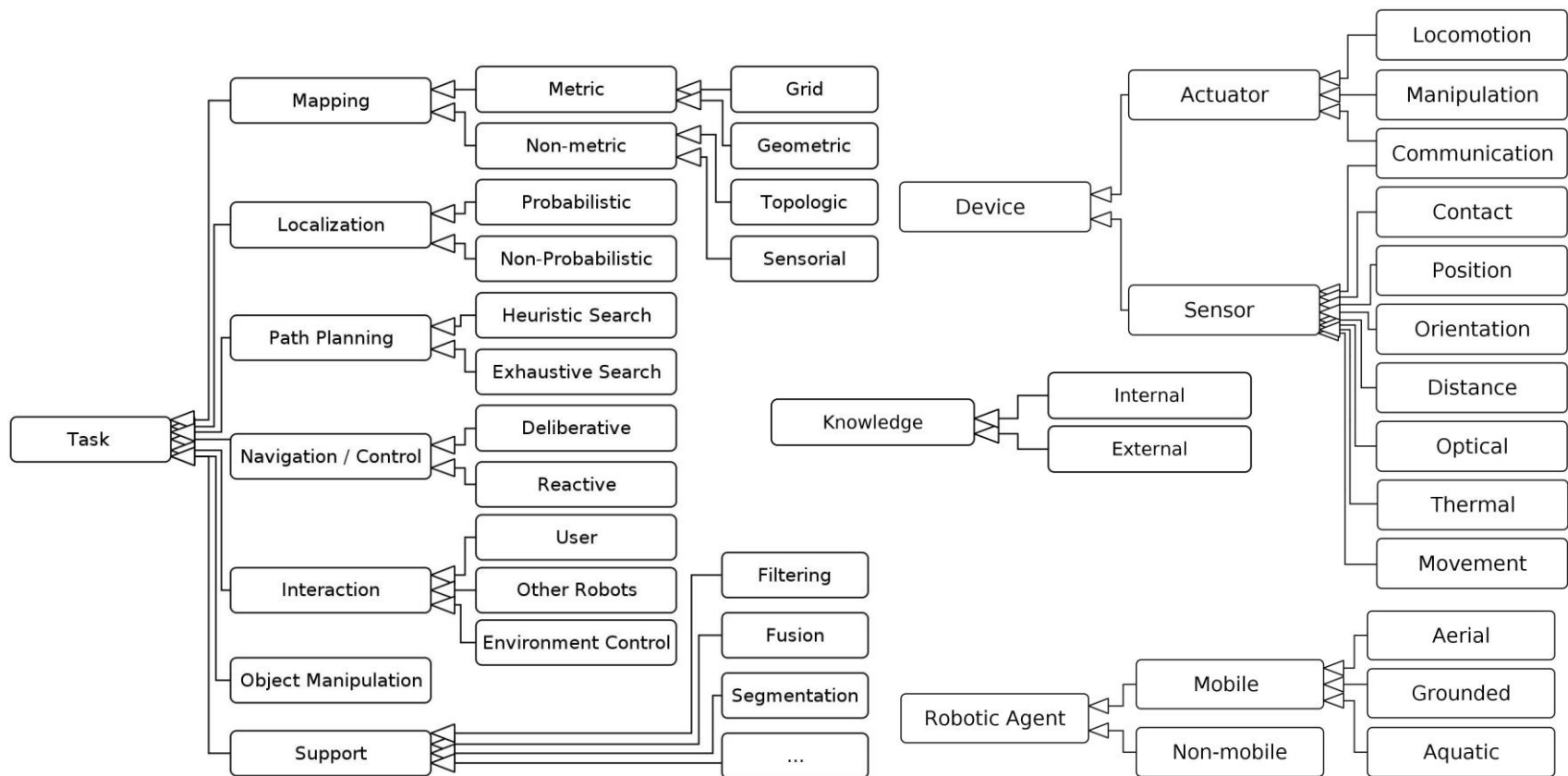
# Introduction

- Main goal:
  - To present RoboSeT (Robotics Services Semantic Search Tool), a mechanism that supports cataloging and discovery of services for robotic systems using semantic information.



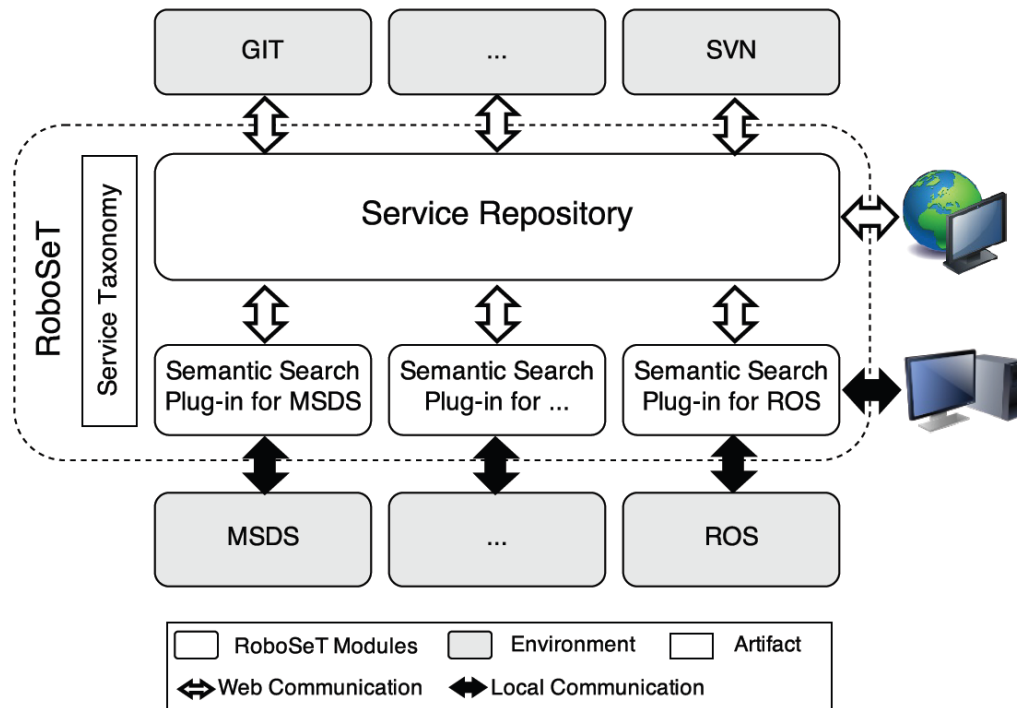
# Developing RoboSeT

- First step: Establishment of a common vocabulary [1]



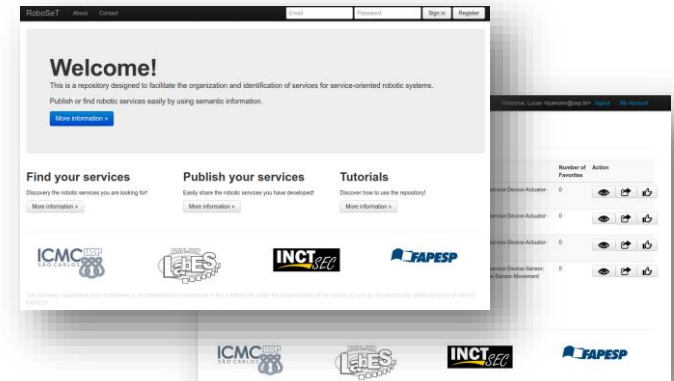
# Developing RoboSeT

- RoboSeT is divided into two main subsystems:
  - Service repository (Web Interface)
  - Service plug-ins (GUI or command line)



# Developing RoboSeT

- Service repository:
  - Account management
  - Service publication
  - Service search and detailing
  - Service management
  - News about services
- Plug-ins:
  - Service search
  - Service identification
  - Service obtaining and deployment
  - Feedback about services (quality, bugs, comments)



# Case study

- Design of a robotic system for robust navigation
  - Motion Planning
  - Trajectory generation
  - Obstacle detection and representation
  - Obstacle avoidance
  - Position and velocity control
  - Localization
  - Laser controller
  - Pioneer P3-DX controller

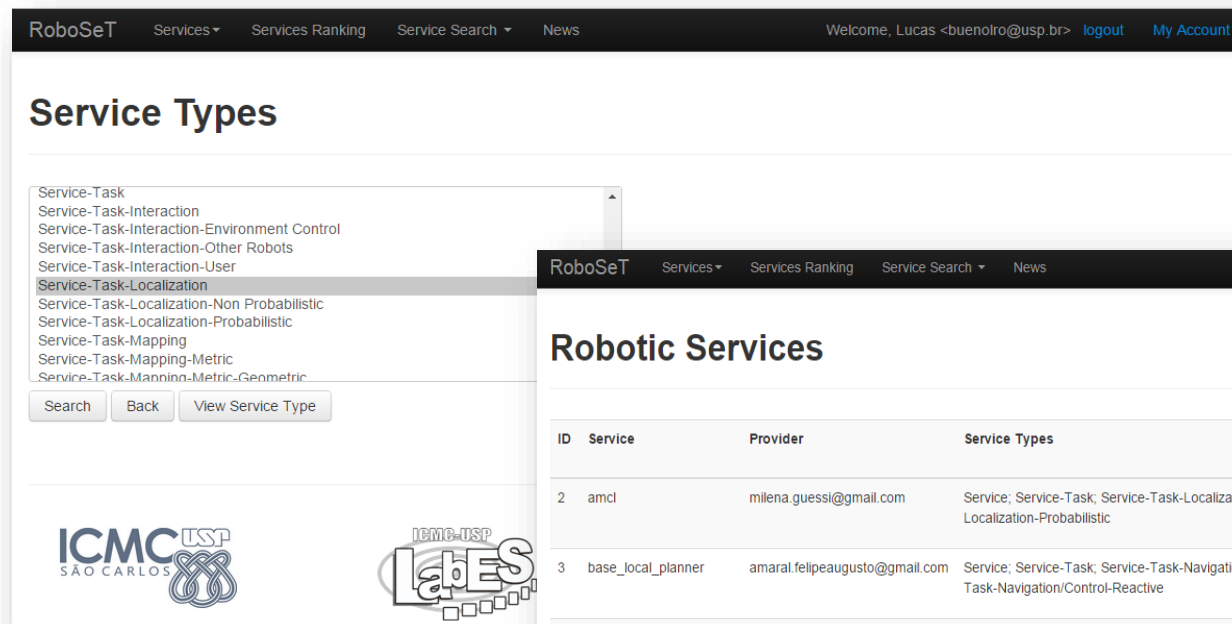
# Case study

- Mapping requirements into service types

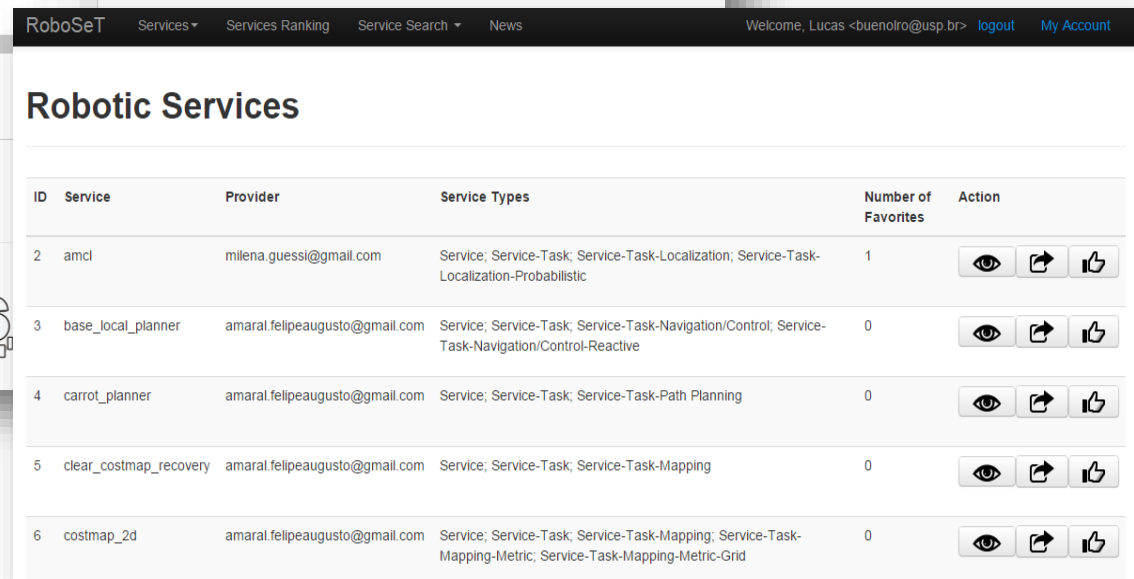
Functionality	Service type
Motion Planning	Service/Task/Path planning
Trajectory generation	Service/Task/Path planning
Obstacle detection and representation	Service/Task/Mapping
Obstacle avoidance	Service/Task/Path planning
Position and velocity control	Service/Task/Navigation
Localization	Service/Task/Localization
Encoder controller	Service/Device/Sensor/Movement
Differential drive controller	Service/Device/Actuator/Locomotion
Laser controller	Service/Device/Sensor/Distance

# Case study
















- Searching for ROS services



The screenshot shows the RoboSeT website interface. The top navigation bar includes 'RoboSeT', 'Services', 'Services Ranking', 'Service Search', and 'News'. A user is logged in as 'Lucas <buenolro@usp.br>' with links for 'logout' and 'My Account'. The main heading is 'Service Types'. A dropdown menu is open, listing various service types: 'Service-Task', 'Service-Task-Interaction', 'Service-Task-Interaction-Environment Control', 'Service-Task-Interaction-Other Robots', 'Service-Task-Interaction-User', 'Service-Task-Localization' (highlighted), 'Service-Task-Localization-Non Probabilistic', 'Service-Task-Localization-Probabilistic', 'Service-Task-Mapping', 'Service-Task-Mapping-Metric', and 'Service-Task-Manning-Metric-Geometric'. Below the list are buttons for 'Search', 'Back', and 'View Service Type'. At the bottom, there are logos for 'ICMC USP SÃO CARLOS' and 'LabES'.



The screenshot shows the RoboSeT website interface with the 'Robotic Services' table. The table lists services with their IDs, names, providers, service types, number of favorites, and action buttons (eye, share, like).

ID	Service	Provider	Service Types	Number of Favorites	Action
2	amcl	milena.guessi@gmail.com	Service; Service-Task; Service-Task-Localization; Service-Task-Localization-Probabilistic	1	  
3	base_local_planner	amaral.felipeaugusto@gmail.com	Service; Service-Task; Service-Task-Navigation/Control; Service-Task-Navigation/Control-Reactive	0	  
4	carrot_planner	amaral.felipeaugusto@gmail.com	Service; Service-Task; Service-Task-Path Planning	0	  
5	clear_costmap_recovery	amaral.felipeaugusto@gmail.com	Service; Service-Task; Service-Task-Mapping	0	  
6	costmap_2d	amaral.felipeaugusto@gmail.com	Service; Service-Task; Service-Task-Mapping; Service-Task-Mapping-Metric; Service-Task-Mapping-Metric-Grid	0	  

# Case study

- Searching for ROS services (Part I)

Functionality	Task service type	ROS Service
Motion Planning	Path planning/Heuristic Search	NavfnROS, CarrotPlanner
Trajectory generation	Path planning/Heuristic Search	TrajectoryPlannerROS, DWAPlannerROS
Obstacle detection and representation	Mapping/Metric/Grid	CostMap2D
Obstacle avoidance	Path planning/Heuristic Search	TrajectoryPlannerROS, DWAPlannerROS
Position and velocity control	Navigation	MoveBase
Localization	Localization/Probabilistic	Amcl

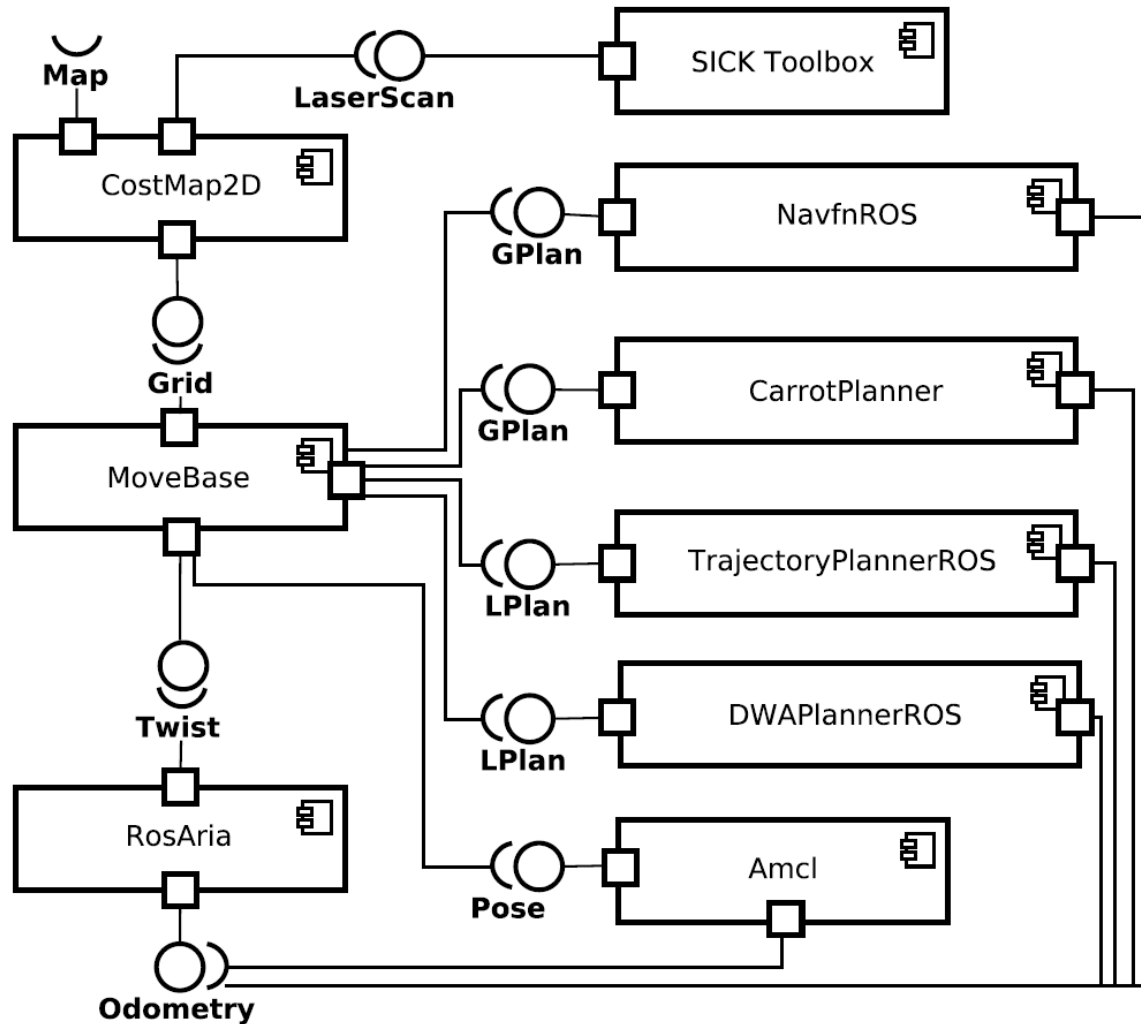


# Case study

- Searching for ROS services (Part II)

Functionality	Device service type	ROS Service
Encoder controller	Sensor/Movement	RosAria
Differential drive controller	Actuator/Locomotion	RosAria
Laser controller	Sensor/Distance	SICK Toolbox

# Case study



# Discussion

- Advantages:
  - Services can be transparently shared and discovered
  - Services that are easier to be found are more likely to be reused
  - Structured information can support identification of more suitable services
  - Reuse improvements positively influence productivity in software systems development
  - Community feedback can guide the development of services of better quality

# Discussion

- Main limitation:
  - RoboSeT is depended on community adoption and cooperation
- Current initiatives to mitigate such limitation:
  - To promote RoboSeT in the robotics community
  - To release an open source version of RoboSeT

# Conclusion and Future Work

- SOA is a promising architectural style for robotics
- A mechanism for supporting cataloging, publishing, and discovery of services can contribute to the SORS development
- Results indicate that RoboSeT can ease the discovery of services for SORS
- Future work:
  - To perform an experiment
  - To develop new functionalities and plug-ins

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